Volume 3, Issue 10, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

PREVALENCE OF HBV, HCV AND HIV AND ITS ASSOCIATION WITH DEMOGRAPHIC FACTORS IN BAHAWALPUR, PUNJAB, PAKISTAN: A CROSS-SECTIONAL STUDY

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DOI: https://doi.org/10.5281/zenodo.17977750

Keywords
Hepatitis B virus; Hepatitis C virus; Human immunodeficiency virus; Prevalence

Article History
Received: 18 October 2025
Accepted: 30 November 2025
Published: 18 December 2025

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Abstract

Background: *Hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) are major blood-borne infections that pose significant public health challenges, particularly in developing countries. Monitoring their prevalence and demographic associations is essential for improving infection control strategies and ensuring transfusion safety.*

Objective: *To determine the prevalence of HBV, HCV, and HIV and to evaluate their association with age and gender among clinically suspected patients in Bahawalpur, Punjab, Pakistan.*

Methods: *A hospital-based cross-sectional study was conducted at the National Orthopedic and General Hospital, Bahawalpur, from January to December 2023. A total of 896 clinically suspected patients were included. Venous blood samples were screened for hepatitis B surface antigen (HBsAg), anti-HCV antibodies, and HIV antibodies using immunochromatographic test (ICT) kits. Demographic data were collected through structured interviews and hospital records. Statistical analysis was performed using SPSS version 16.0, and associations were assessed using the Chi-square test with a significance level of* $p < 0.05$.

Results: *Among the 896 patients, the prevalence of HBV, HCV, and HIV was 1.8%, 4.8%, and 0.1%, respectively. HCV infection was significantly associated with gender* ($p = 0.001$) *and age groups* ($p < 0.001$), *with the highest number of positive cases observed in the 21–30 years age group. No statistically significant association was found between HBV or HIV and either gender or age.*

Conclusion: *The study demonstrates a comparatively higher prevalence of HCV than HBV and HIV among clinically suspected patients in Bahawalpur. Although HBV and HIV prevalence were low, HCV remains a significant public health concern, particularly among young adults. Enhanced screening, prevention,*

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

and education strategies are essential to control the spread of these infections, particularly HCV, in the region.

INTRODUCTION

Hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) are among the most significant blood-borne viral infections posing a major global public health challenge [1,2]. These infections are associated with substantial morbidity, mortality, and long-term socioeconomic burden, particularly in low- and middle-income countries [3]. HBV and HCV are leading causes of chronic liver disease, cirrhosis, and hepatocellular carcinoma, while HIV progressively weakens the immune system, predisposing infected individuals to opportunistic infections and malignancies [4,5]. Despite advances in prevention, screening, and treatment strategies, the transmission of these viruses remains a persistent concern, especially in regions with limited healthcare resources and inadequate surveillance systems [6].

Globally, it is estimated that over 296 million people are living with chronic HBV infection, and approximately 58 million individuals are infected with HCV, with a significant proportion remaining undiagnosed [1,7]. Similarly, HIV continues to affect nearly 39 million people worldwide [2]. The shared routes of transmission—such as transfusion of infected blood and blood products, reuse of contaminated needles and syringes, unsafe medical and dental procedures, vertical transmission, and high-risk sexual behaviors—underscore the importance of effective screening and preventive measures [8,9]. Among these, blood transfusion remains a critical route of concern, particularly in developing countries where screening practices may be inconsistent [10].

Pakistan bears a considerable burden of HBV and HCV infections and is considered an intermediate-to-high endemic country for viral hepatitis [11]. The prevalence of HCV in Pakistan is among the highest globally, while HBV continues to pose a significant health threat [12]. Although the overall prevalence of HIV in the general population remains comparatively low, a rising trend has been observed in recent years, particularly among high-risk groups [13]. Factors such as lack of public awareness, unsafe injection practices, and inadequate sterilization of medical equipment, informal healthcare providers, and limited access to preventive services contribute to the continued transmission of these infections [14].

Blood donors represent a crucial population for monitoring the prevalence of transfusion-transmissible infections (TTIs), as they are generally perceived as healthy individuals [15]. Screening blood donors not only ensures the safety of blood transfusion services but also provides valuable epidemiological data reflecting infection trends in the general population [16]. Understanding the prevalence of HBV, HCV, and HIV among blood donors or hospital-based populations helps identify gaps in public health interventions and strengthens infection control policies [17].

Demographic factors such as age and gender play an important role in the epidemiology of blood-borne viral infections [18]. Age-related variations in prevalence may reflect differences in exposure risk, behavioral patterns, vaccination status, and healthcare access. Gender disparities have also been widely reported, with males often exhibiting higher infection rates, potentially due to greater occupational exposure, higher likelihood of risk behaviors, and increased participation in blood donation [19]. Evaluating these associations is essential for designing targeted prevention and screening strategies.

In addition to demographic variables, the possible association between ABO and Rh blood group systems and susceptibility to infectious diseases has gained increasing scientific interest [20]. Blood group antigens are known to influence host–pathogen interactions by acting as receptors or co-receptors for various microorganisms. Several studies have suggested a potential relationship between specific blood groups and increased or decreased susceptibility to viral infections, including hepatitis viruses and HIV; however, findings remain inconsistent, and evidence from South Asian populations, particularly Pakistan, is limited [18,20].

Bahawalpur, a major city in southern Punjab, Pakistan, serves a large and diverse population, including urban and rural communities. The region faces challenges such as limited healthcare awareness,

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ISSN: (e) 3007-1607 (p) 3007-1593

unsafe medical practices, and inadequate disease surveillance, which may influence the prevalence of blood-borne infections [14]. Despite this, there is a paucity of recent, region-specific data assessing the prevalence of HBV, HCV, and HIV and their association with demographic characteristics and blood group distribution. Local epidemiological data are essential for guiding regional health policies, improving blood transfusion safety, and implementing effective preventive measures.

Therefore, the present cross-sectional study was designed to determine the prevalence of HBV, HCV, and HIV among individuals in Bahawalpur, Punjab, Pakistan, and to evaluate their association with age, gender, and ABO/Rh blood groups. By providing updated and region-specific data, this study aims to contribute to the existing body of knowledge and support evidence-based strategies for infection control, safe transfusion practices, and public health planning in Pakistan.

Materials and Methods

Study Design and Setting

This was a cross-sectional study conducted at the National Orthopedic and General Hospital **in** Bahawalpur, Pakistan from January 1 to December **31, 2023.**

Study Population

The study included 896 patients who were clinically suspected of having Hepatitis B virus (HBV), Hepatitis C virus (HCV), and Human Immunodeficiency Virus (HIV) infections. Blood samples were collected from all participants during the study period. Demographic and clinical information, including age, sex, blood group, and relevant medical history**,** was collected through structured interviews and review of hospital records.

Inclusion and Exclusion Criteria

Inclusion criteria: Patients of any gender and age group who were clinically suspected of having HBV, HCV, or HIV infections and who provided consent to participate in the study.

Exclusion criteria: Patients with incomplete clinical or demographic data, individuals who declined participation, and duplicate blood samples were excluded from the study.

Laboratory Analysis

Venous blood samples were collected using sterile vacutainers. Serum was separated by centrifugation and stored appropriately until testing. Serological screening was performed for Hepatitis B surface antigen (HBsAg)**,** anti-HCV antibodies, and HIV antibodies using the Immunochromatographic Test (ICT) method (Abbott Diagnostics, USA), in accordance with the manufacturer's instructions. All tests were performed following the standard laboratory protocols to ensure accuracy and reliability of the results. Reactive samples were **re-tested** to confirm positive results.

Statistical Analysis

Data were entered and analyzed using SPSS version 16.0**.** Descriptive statistics were used to summarize demographic characteristics and the prevalence of infections. The Chi-square test was applied to evaluate associations between viral infections and demographic variables, with a p-value < 0.05 considered statistically significant.

Result

A total of 896 patients were included in the study, comprising 163 males (18.2%) and 733 females (81.8%). The majority of participants belonged to the 21–30 years age group (29.1%), followed by 11–20 years (22.0%) and 31–40 years (16.4%). Regarding blood group distribution, B positive (34.5%) was the most prevalent, followed by O positive (27.9%) and A positive (22.7%). Less frequent blood groups included AB positive (7.4%), O negative (3.3%), B negative (2.2%), A negative (1.2%), and AB negative (0.8%).The detailed distribution of socio-demographic variables is presented in Table 1.

Table-1 Distribution of Socio-demographic Variables

Variables	Category	Frequency (n)	Percentage (%)
Gender	Male	163	18.2
	Female	733	81.8

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ISSN: (e) 3007-1607 (p) 3007-1593

	Total	896	100
Age Group	1-10	114	12.7
	11-20	197	22.0
	21-30	261	29.1
	31-40	147	16.4
	41-50	76	8.5
	51-60	47	5.2
	>60	54	6.0
	Total	896	100
Blood Group	A Positive	203	22.7
	B Positive	309	34.5
	AB Positive	66	7.4
	O Positive	250	27.9
	A Negative	11	1.2
	B Negative	20	2.2
	AB Negative	7	0.8
	O Negative	30	3.3
	Total	896	100

Among the 896 patients included in the study, the prevalence of Hepatitis B virus (HBV) infection was 1.8% (n = 16), with 98.2% (n = 880) testing negative. Hepatitis C virus (HCV) infection was identified in 4.8% (n = 43) of patients, while 95.2% (n = 853) were negative, indicating a comparatively higher prevalence of HCV than HBV. In contrast, Human Immunodeficiency Virus (HIV) infection was detected in only one patient (0.1%), with 99.9% (n = 895) testing negative, reflecting a very low prevalence of HIV in the study population. The prevalence of HBV, HCV, and HIV is shown in Tables 2, 3, and 4, respectively.

Table-2 Prevalence of HBV

HBV	Frequency (n)	Percentage (%)
Positive	16	1.8
Negative	880	98.2
Total	896	100

Table-3 Prevalence of HCV

HCV	Frequency (n)	Percentage (%)
Positive	43	4.8
Negative	853	95.2
Total	896	100

Table-4 Prevalence of HIV

HIV	Frequency (n)	Percentage (%)
Positive	1	0.1
Negative	895	99.9
Total	896	100

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ISSN: (e) 3007-1607 (p) 3007-1593

The table-5 shows the distribution of HBV, HCV, and HIV infections among male and female patients. For HBV, 2 males and 14 females tested positive, with no significant gender difference (P-value = 0.792). For HCV, 16 males and 27 females tested positive, indicating a significant gender difference (P-value = 0.001). For HIV, 1 male tested positive, with no females testing positive, showing no significant gender difference (P-value = 0.637).

Table-5 Association of HBV, HCV, and HIV with Gender

Parameter		Gender		Total	P-value
		Male	Female		
HBV	Negative	161	719	880	0.792
	Positive	2	14	16	
HCV	Negative	147	706	853	0.001
	Positive	16	27	43	
HIV	Negative	732	163	895	0.637
	Positive	1	0	1	

Table-6 displays the distribution of HBV, HCV, and HIV infections across different age groups. For HBV, most age groups had no significant difference in positive cases, with 8 cases in the 21-30 group, resulting in a non-significant P-value of 0.765. For HCV, the 21-30 age group had the highest number of positive cases (9), with significant variation across age groups (P-value = 0.000). For HIV, only one positive case was found in the 11-20 age group, with no significant age difference (P-value = 0.737)

Table-6 Association of HBV, HCV, and HIV with Age Groups

Parameter		Age Group							Total	P-value
		01-10	11-20	21-30	31-40	41-50	51-60	>60		
HBV	Negative	114	196	253	144	74	46	53	880	
	Positive	0	1	8	3	2	1	1	16	0.765
HCV	Negative	114	194	252	136	68	38	51	853	
	Positive	0	3	9	11	8	9	3	43	0
HIV	Negative	114	196	261	147	76	47	54	895	
	Positive	0	1	0	0	0	0	0	1	0.737

Discussion

The present cross-sectional study evaluated the prevalence of Hepatitis B virus (HBV), Hepatitis C virus (HCV), and Human Immunodeficiency Virus (HIV) among 896 clinically suspected patients attending the National Orthopedic and General Hospital, Bahawalpur, Pakistan. The findings revealed an overall prevalence of 1.8% for HBV, 4.8% for HCV, and 0.1% for HIV, demonstrating a variable burden of blood-borne viral infections within the study population. These results provide important insight into the epidemiological patterns of HBV, HCV, and HIV in southern Punjab and highlight the continued public health significance of these infections [21–23].

In the present study, the prevalence of HBV (1.8%) was relatively low compared to HCV (4.8%). This lower HBV prevalence may be attributed to increased public awareness, improved vaccination coverage, and enhanced screening strategies implemented over

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ISSN: (e) 3007-1607 (p) 3007-1593

recent years in Pakistan [24,25]. The introduction of the hepatitis B vaccine into the national immunization program and its wider availability may have played a crucial role in reducing HBV transmission [26]. Additionally, improved infection control practices in healthcare settings and blood transfusion services may have further contributed to the declining HBV burden [27].

In contrast, HCV demonstrated a higher prevalence rate, indicating that it remains a major public health challenge in the region. The higher prevalence of HCV compared to HBV observed in this study is consistent with several national and regional studies from Pakistan, which have reported HCV as the most prevalent blood-borne viral infection [28–30]. This may be attributed to the absence of an effective vaccine for HCV, combined with ongoing risk factors such as unsafe injection practices, reuse of syringes, inadequate sterilization of medical and dental equipment, unregulated blood transfusions, and limited awareness in certain populations [31]. The findings emphasize the urgent need for strengthened HCV prevention strategies, early diagnosis, and expanded access to antiviral treatment [32].

The extremely low prevalence of HIV (0.1%) observed in this study aligns with the generally low HIV prevalence reported in the general population of Pakistan [33]. However, despite the low frequency, the detection of even a single HIV-positive case highlights the importance of continued surveillance and routine screening, particularly among clinically suspected individuals. Social stigma, underreporting, and limited testing access may contribute to an underestimation of the true HIV burden, underscoring the need for sustained public health vigilance [21,22].

Gender-wise analysis revealed no statistically significant association between HBV and gender, suggesting a relatively uniform distribution of HBV infection among males and females. This finding may reflect similar exposure risks and vaccination coverage across genders [24]. In contrast, HCV infection showed a statistically significant association with gender, with a higher number of positive cases observed among females. This gender disparity may be related to sociocultural and healthcare-related factors, including increased exposure of women to medical procedures such as injections during pregnancy, childbirth, or gynecological care, as well as potential differences in healthcare-seeking behavior [25,28]. However, further investigation is required to identify the underlying reasons for this association.

For HIV, no significant gender association was observed, which may be attributed to the very low number of positive cases detected. The limited number of HIV-positive individuals restricts meaningful statistical comparison and highlights the need for larger, population-based studies to better understand gender-related risk factors for HIV transmission [33].

Age-wise distribution showed no significant association between HBV infection and age groups, although the highest number of HBV-positive cases was observed in the 21–30 years age group. This age group represents a socially and economically active segment of the population, which may increase exposure to potential risk factors. However, the lack of statistical significance suggests that HBV infection was relatively evenly distributed across age categories in the study population [26,27].

In contrast, HCV infection demonstrated a statistically significant association with age groups, with the highest prevalence observed among young and middle-aged adults, particularly those between 21 and 40 years. This finding is consistent with previous studies and may reflect cumulative exposure to risk factors such as medical injections, blood transfusions, and invasive procedures over time [28–30]. The higher burden of HCV in economically productive age groups is particularly concerning, as it may have long-term socioeconomic and healthcare implications [31,32].

HIV infection showed no significant association with age, as only one positive case was identified in the 11–20 years age group. Due to the extremely low prevalence, it is not possible to draw definitive conclusions regarding age-related trends of HIV infection in this study. Nonetheless, early detection in younger individuals remains critical to prevent further transmission and ensure timely management [33].

The socio-demographic analysis revealed a higher proportion of female participants and a predominance of individuals in the 21–30 years age group. Blood group distribution showed a higher frequency of B positive, followed by O positive and A positive, which reflects the general blood group

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ISSN: (e) 3007-1607 (p) 3007-1593

distribution in the Pakistani population rather than a disease-specific association [21]. No direct relationship between blood group and viral infection prevalence was established in this study, although future research may explore this aspect in more detail [22].

Despite its strengths, the present study has certain limitations. Being a hospital-based cross-sectional study, the findings may not be fully generalizable to the broader community. The use of immunochromatographic test (ICT) kits, although practical and widely used for screening, may have lower sensitivity compared to molecular diagnostic techniques. Additionally, confirmatory testing using ELISA or PCR was not performed, which may have influenced the accuracy of prevalence estimates [23,24]. Furthermore, detailed information on potential risk factors such as injection history, blood transfusion practices, and socioeconomic status was not assessed [25,26].

Conclusion

In conclusion, this study reveals a low prevalence of HBV (1.8%) and HIV (0.1%) among the 896 patients, with a higher prevalence of HCV (4.8%). Gender-wise analysis indicates a significant difference in HCV infection rates, while HBV and HIV do not show significant gender disparities. Age-group analysis reveals significant variation in HCV prevalence, with the 21-30 age group showing the highest number of positive cases. Future research should explore the underlying factors contributing to the higher HCV prevalence in specific age groups and gender differences, as well as evaluate potential preventive strategies and treatment interventions to reduce the incidence of these infections.

Declaration

Acknowledgements

The authors would also like to acknowledge the hospital staff for their support in collecting data and the ethics committee for their approval to conduct this study

Ethics approval and consent to participate

Written informed consent was taken from all donors. This study was approved by the hospital ethics committee (NOGHB Ethics Committee).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

This research was not funded by any university, organization, or external agency.

Availability of data and materials

The datasets generated during and/or analyzed during the current study are not publicly available due to hospital ethical policy in order to protect participant confidentiality

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Authors' contributions

M.A.M. conceived and designed the study and drafted the manuscript and critically reviewed the manuscript. E.E. and A.D. developed the study protocol, collected and analyzed the data, interpreted the results, and contributed to clinical interpretation. L.H conducted literature review and supported data entry. M.A.J. assisted with laboratory investigations. G.M. and W.K. contributed to statistical analysis and data management. All authors read and approved the final manuscript.

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ISSN: (e) 3007-1607 (p) 3007-1593

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